

# The Investment in the Information Technology and Supply Chain Operational Performance: Mediating Role of Supply Chain Capabilities

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**Abstract**—The main purpose of the current study is to examine the impact of the investment on the information technology on the supply chain operational performance. Additionally, the study has examined the mediating role of supply chain capabilities namely the relational capability, IT capability and organizational culture is examined in the relationship between information technology and the supply chain operational performance. Meanwhile, research designed for discovering sources of IT productivity paradox are expected to influence and offer implications for Indonesian companies as well as for other developing economies, who strive for creating business value of IT. The data is collected from the Indonesian manufacturing firms and the response rate for survey was obtained as 75.1%. The SEM-PLS is employed in the study to examine the relationship between and among the variables. IT capabilities are identified as critical for enhancing supply chain performance and also one of the major factors of Supply chain management. The significance of IT and SCM are the widely studied areas, and we also found some studies that investigated supply chain capability as a mediator in context to IT influencing supply chain operational performance. SCC have also been identified as the organizational ability to coordinate SC processes, and be responsive against requests of SC partners and consumer needs and share information resources

**Keywords;** Information Technology, Supply Chain Operational Performance, Supply Chain Capabilities

## 1. Background

Since the past few years, Indonesian firms have been heavily investing in Information Technology (IT). The IT applications' prevalence provides Indonesian firms with new opportunities for enhancing their management capabilities. According to a survey, SMEs in China have made huge IT investments, approaching to a level of US\$3 billion [1], with a minimum improvement in competitiveness and operational performance. Therefore, 'productivity paradox' is a key issue in the information systems management, which is the difference among lack of benefits from technology investments and the

significant improvements in underlying technology [2].

From the context of information technology, the business-BPR view states that significant part of IT business value comes from its interrelationships with the business BPR (BPR) [3]. In particular, IT significantly influences BPR which thus influence operational performance. In an attempt to study the role of BPR as a mediator on IT and firm performance relationship, a framework was established [4]. Their study suggests that a firm's BPR and functions depend on the infrastructure provided by the information technology. With the advancements in information system (IS), business BPR management capabilities have been identified as the key mediators among SC performance and IT capability. Furthermore, in [5] study, the game theory was incorporated to show optimal match conditions among management capabilities and IT application level to influence performance through IT. Therefore, using too little or too much IT capability refers to the inefficient utilization of organizational resources.

In developed economies, business value of IT has been extensively researched. However, in developing countries, like China, empirical work in this area is still evolving and is questionable and unknown that whether outcomes obtained in case of developed countries can be generalized to the developing economies [6]. Evidently, the difference in organizational structures, cultures and economic development stages in developing and developed economies may influence business value of IT. Practitioners and academics have also been emphasizing upon issues concerning operational performance and IT investment [7]. Empirical study in this context as well as results from existing studies in China have shown inconsistent outcomes. Such as, a study [8] investigated the return on IT investments that were made in manufacturing industry in China and reported improvement in firm performance. Furthermore, [9] studied the case of Malaysian local and foreign electronics firms and found positive correlation between productivity

and technology intensity. In another study [10] internal data of China's state-owned commercial bank was used and discovered that making investments on IT assets negatively influence the bank's marginal productivity. In addition, insignificant impact of IT investment was found on SC performance in China, for publicly listed companies. Another study [11] revealed that operational performance and IT investment in China are negatively correlated for publicly listed IT companies. Thus, the above-mentioned findings show certain features of IT productivity paradox.

## 2. Literature review

Organizations under volatile environment tries to reach for superior operational performance and competitive advantages [12, 33-34]. Resultantly, several extensive researches have been conducted to investigate the SC management's key contributions to enhance operational performance as well as the effects of SCC (SCC) and SC integration (SCI) to help achieve superior operational performance. A few researchers [13] also linked SC BPR integration (SCI) constructs with the financial performance constructs, while others [14] linked SC BPR integration constructs with market-based measures. SCM scholars generally view operational performance as the competitive and operational performance dimensions, and also examined SCI's critical role in improving operational performance. Furthermore, SC partners having compatible procedures, BPR and systems may involve in their resource and capabilities sharing, leading to the improvement in competitiveness and operational performance throughout the SC. Thus, compatible SC BPR integration ensures right product availability, at the right time, competitive price and to the right consumers, resulting in the improvement in partners' competitive as well as operational performance [15]

[16] stated that resource-based view (RBV) researchers assume all firms to have diverse capabilities and resources which may seem difficult and costly to implement and duplicate by the competitors. Therefore, to achieve competitive advantage in today's global market, an organization must have the ability to quickly respond to its competitors' actions, particularly by emphasizing on quality, cost, flexibility and speed. In addition, relational capability of SC is one of the critical factors in operational performance of SC [17]. Besides, there is equal importance of organizational culture capability and IT capability in SC's operational performance. Several SCM researchers [18] have reported that customer relationship, information quality, information sharing, and supplier partnership increase the operational performance of SC. Thus, higher customer relationship, information sharing and supplier partnership are likely to improve SC reliability, optimize SC cost, add flexibility in managing demand and supply uncertainties and improve SC

responsiveness [19]. For tin companies, supplier partnership is crucial as it enables to quickly respond against continuously changing market demand. [20] also supported this finding. Therefore, primary benefit of supplier partnership is that a timely and consistent delivery of quality materials can be assured from the suppliers. Such as, in Wal-Mart and Procter and Gamble (P&G) partnership, Wal-Mart is a capital and information rich retailer, and P&G is a capital and information rich manufacturer, which can turn out be a win-win cooperation by sharing information throughout the SC, and will consequently result in superior SC performance and mutual benefits. Briefly, it is concluded that good supplier partnership may have positive impact on the organization's operational performance, while less reliance on supplier partnership may result in worst SCP [21].

IT capabilities are identified as critical for enhancing SC performance and also one of the major factors of SC management (SCM). [22] suggest significant direct association between SC performance and IT capability. In particular, several researchers observed IT infrastructure as the most important factor to improve operational agility and minimize costs. Furthermore, IT infrastructure positively influences transparency and reduces corruption, simultaneously. Information technology (IT) personnel is considered to be a key IT products and services enabler for the smooth flow of business operations [23]. IT personnel proposes appropriate technical solutions for resolving IT based business problems. In view of [24] IT personnel uses IT infrastructure flexibility for suggesting appropriate solutions to the management. Thus, agility performance of an organization is found to be directly and positively influenced by the IT personnel. Besides, for many years, organizational culture has been considered to be a critical operational performance factor, and directly affects the success or failure of an organization. Several researchers have also indicated that organizational goals and organizational culture must be aligned, particularly because culture positively and significantly influence global SCM responsiveness, SC performance, and SC flexibility [25]. [25] also reported significant effect of organizational culture on SMEs SC performance in Malaysia. In addition, [2] studied the case of 218 SC professionals from Institute of Supply Management (ISM), New York, and revealed a positive direct association among SC performance and organizational culture.

Business value of IT has remained the main focus of MIS literature. Such as, several scholars [26] and [27] posited that IT investments generate considerable returns as compared to other capital investments that are made for production BPR. It has also been argued that information technology generates business value through enhancing the efficiency of intermediary BPR. Furthermore, a few

researchers [1] and [3] suggest that SC performance improves through information technology (IT) by developing immobile, path-dependent and unique strategic capabilities and resources. While [28] claimed that IT value depends on its flexibility and its option providing ability to the firms under uncertain and competitive market environments. Moreover, [4] proclaimed in their study that a company's IT investment efficiency can be increased by producing IT capabilities. They also discerned that firms possessed with high IT capabilities are likely to exhibit more sustainable and greater performance, as compared to firms having lower IT capabilities. [6] considered and used prisoner's dilemma and hypothesized that IT vendors' cause difficulty for companies to gain through their IT investments using dynamic interactions among competitors, vendors and firms. A study of [29] provides empirical evidence that different IT capability dimensions pose different effects on measures of performance. In this context, BPR-based view is one of the most well-known theories for explaining that in what ways IT plays its role in SC performance. According to this view, IT investments positively affect productivity and performance by enabling to create new BPR, new business capabilities as well as by improving the existing BPR. It thus implies that in functional areas, IT has first-order effects on variables at operational level, which in turn influence higher-level factors, like profitability and productivity. In study of [7] they used IT asset's concept and stated that desirable IT investment outcomes cannot be realized if an organization fails to properly manage its assets, whereas, the IT's impact on SCP is an outcome of the association among BPR and IT. The study by [8] found that products and value chain's information intensities mediate information technology's impact on BPR. Another study of [9] obtained the data from 60 business units from 20 large firms to carry out firm-level analysis, to assess the association among operational costs and IT investment. They reported that higher IT investment yields lower operating and production costs. In addition, BPR management capability acts as a mediator in the performance and IT relationship. [11] defined BPR management capability as the ability of developing BPR with adequate richness and reach to guide the SC activities, and financial activities etc. BPR management is considered as a competitive advantage source. Thus, it is essential to develop ability of effectively managing BPR for the success and survival of organizations. Several researchers have argued IT as a critical factor in developing BPR management capability based on its ability of enhancing BPR quality and BPR output and minimizing BPR variability.

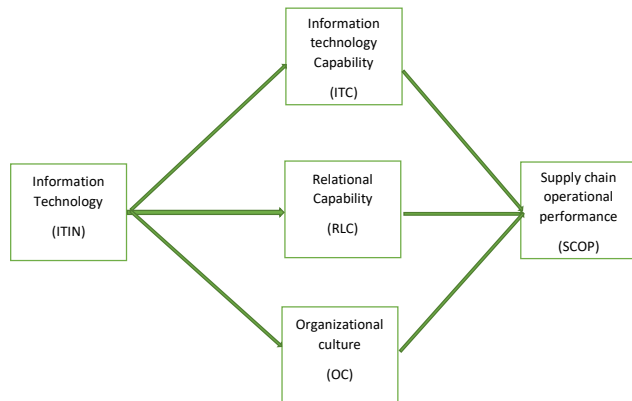
The research on the difference between external SCM capability and internal BPR management capability is quite limited. According to [30] the traditional inter-

organizational competition has been expanded to inter-SC competition. Another study [10] discovered SC management as a core capability, therefore, competitive advantage can be achieved through quality SC. Furthermore, [12] found that information sharing plays a significant role in SCM. In particular, they also identified data accuracy as an essential component for designing agile SCM BPR and for efficient forecasting. However, the significance of IT and SCM are the widely studied areas, and we also found some studies that investigated SC capability as a mediator in context to IT influencing SC performance (SCP). Present research used the BPR-view literature and tries to analyze the distinct impact of internal business BPR as a mediator to that of SC management (SCM) capability.

[31] defined SC capabilities (SCC) as the attributes, organizational BPR, abilities, skills and knowledge which enable firm to achieve sustained competitive advantage and superior performance over competitors. SCC creates a linkage among operational performance and SC BPR integration. A few researchers referred SCC as an organizational ability to utilize external and internal resources for achieving superior SCP [8]. SCC have also been identified as the organizational ability to coordinate SC BPR, and be responsive against requests of SC partners and consumer needs and share information resources [9]. Therefore, following [9] they have conceptualized SCC as a second-order construct, comprised of SC coordination, SC responsiveness, and information sharing.

Literature suggests that there exists a positive association among operational performance and SCC. Dynamic capability theory states that distinctive SCC that are developed via SC BPR integration, allows to achieve competitive advantage by the SC partners. According to [10] SCC increase market share and sales volume of partnering firms through efficient and effective product delivery to the consumers. In addition, they also enable entry of SC partners to those markets which were inaccessible earlier, due to distribution constraints and individual operations. In addition, the SCC (SCC) allow effective response of downstream SC partners against customer queries, which thus contribute towards better operational performance [12]. [13] found positive association among operational performance and SC dynamic capability. Information sharing and SC coordination as SCC, also significantly play their role in achieving superior competitive performance and operational performance at firm level. According to the prior literature, SC BPR integration not always result in operational performance, since performance greatly relies upon those SCC that develop from integration BPR. Thus, competitive and distinctive SCC must be developed to improve operational performance. Moreover, such capabilities provide unique market position and superior

benefits to the organizations [14]. Furthermore, capabilities of integration led SC partners complement one another, which thus improves competitive and operational performance of all partnering firms. Thus, SCC play the role of a mediator on operational performance and IT nexus.



**Figure 1. Conceptual Framework**

H1: ITIN has significant impact on the SCOP.

H2: ITIN has significant impact on the ITC.

H3: ITIN has significant impact on the RLC.

H4: ITIN has significant impact on the OC.

H5: ITC has significant impact on the SCOP.

H6: RLC has significant impact on the SCOP.

H7: OC has significant impact on the SCOP.

H8: ITC mediates the relationship between the ITIN and SCOP.

H9: RLC mediates the relationship between the ITIN and SCOP

H10: OC mediates the relationship between the ITIN and SCOP

### 3. Methodology

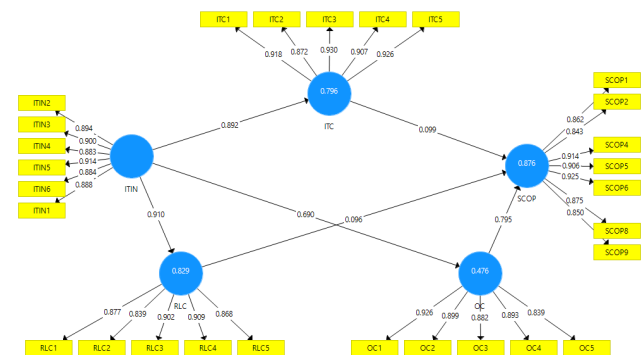
Survey-based methodology is employed in this research by distributing 358 questionnaires to the Insurance companies' employees in Palestine. The data collection process took place during April 2019- June 2019, and 136 questionnaires were received by the end of April and 121 by the end of May. The remaining questionnaires were obtained in June 2019. From 358 distributed questionnaires, around 269 were returned back by the respondents, where 11 questionnaires had some technical errors (such as, incomplete surveys or missing responses), and were excluded from the data analysis. Therefore, the response rate for survey was obtained as 75.1%. The present study extracted the supply chain operational performance was adopted from [15] and supply chain capability from [16]

In this study, Structural Equation Modeling (SEM) and SPSS v. 20.0 were used for data analysis. Besides, the study also obtained a combination of descriptive and inferential statistics, followed by the application of PLS-

SEM (Partial least square structural equation modeling) due to its distinctive features, thereby indicating it as a potential alternative approach to CB-SEM approach. According to [17] this technique has also been employed in various business studies and in practice.

### 4. Results

Prior to assessing the overall model relationships, the researcher is required to ensure the validity and reliability of the measuring constructs, used in the study. Thus, at the initial stage of measurement model assessment, the validity and reliability of the constructs and items were tested, followed by the assessment of construct/item reliability by testing the respective item loadings on their respective construct [32].



**Figure 2. Measurement Model**

Factor or indicator loadings must turn out to be 0.70 or above. Factor loadings test in measurement model is considered to be essential and vital to examine each item loading on their respective constructs. Thus, the higher the consistency among items of a particular construct, the greater will be the factor loading. Results for factor loading are expected to be higher than the standardized value, i.e. 0.70. Therefore, value for any factor loadings which is higher than 0.70 indicates stronger consistency among measurement constructs (Hair et al., 2016). All the scores for factor loadings were found to be above 0.70, as shown in Table 4.7.

**Table 1. Outer Loading**

	ITC	ITIN	OC	RLC	SCOP
ITC1	0.918				
ITC2	0.872				
ITC3	0.930				
ITC4	0.907				
ITC5	0.926				
ITIN2		0.894			
ITIN3		0.900			
ITIN4		0.883			
ITIN5		0.914			
ITIN6		0.884			

OC1			0.926		
OC2			0.899		
OC3			0.882		
OC4			0.893		
OC5			0.839		
RLC1				0.877	
RLC2				0.839	
RLC3				0.902	
RLC4				0.909	
RLC5				0.868	
SCOP1					0.862
SCOP2					0.843
SCOP4					0.914
SCOP5					0.906
SCOP6					0.925
SCOP8					0.875
SCOP9					0.850
ITIN1		0.888			

Convergent validity is referred as a degree that high common variance is shared among all the items measuring a particular construct [23, 25]. For observing convergent validity between the items of a construct, several methods are used, for instance, composite reliability (CR), average variance extracted (AVE) and outer or factor loadings. Where, composite reliability shows the level that a group of items are consistently estimating a particular construct. Composite reliability estimates overall reliability of a group of similar rather heterogeneous items. It also examines shared variance among indicators through obtaining item loadings for concepts within the nomological network. Another common measure for assessing convergent validity at construct level, is the average variance extracted (AVE), which is the average percentage of the extracted common variance between the observed variables of a construct [16].

Table 2. Reliability

	Cronbach's Alpha	rho_A	CR	(AVE)
ITC	0.948	0.950	0.960	0.829
ITIN	0.950	0.950	0.960	0.799
OC	0.933	0.934	0.949	0.789
RLC	0.926	0.927	0.944	0.773
SCOP	0.953	0.954	0.961	0.779

A discriminant validity indicator measures the construct validity and shows the extent that a particular model construct is truly and empirically distinctive from the rest of the model constructs. Thus, in order to establish adequate discriminant validity, a construct is expected to be unique and estimate that phenomena which does not symbolize phenomena measured by other any model

constructs [21]. Therefore, discriminant validity contributes by ascertaining that strong correlation exists among construct and its own measures, and not with any other constructs. In this regard, overlapping in variance can be examined.

Table 3. Validity

	ITC	ITIN	OC	RLC	SCOP
ITC	0.901				
ITIN	0.892	0.894			
OC	0.849	0.790	0.888		
RLC	0.716	0.710	0.795	0.879	
SCOP	0.702	0.689	0.726	0.739	0.883

Next to the measurement model estimation is the evaluation of structural model, which indicates assessing the relationships among model constructs and the predictive capability of the model.

[16] suggest that hypothesis testing or individual path-coefficients in the PLS structural model is generally explained as the standardized OLS beta-coefficients. For assessing all path-coefficients' significance, the bootstrapping procedure is used. However, those paths which indicate hypothesized direction, are not in support of prior hypotheses, while paths which are significant and indicate empirical hypothesized direction thus support the hypothesized causal relationship. Direct paths for all the coefficients were found to be significant at  $p < 0.5$ .

Table 4. Direct Relationship

	(O)	(M)	(STDEV)	( O/STDEV )	P Values
ITC -> SCOP	0.299	0.304	0.082	4.203	0.000
ITIN -> ITC	0.892	0.892	0.022	41.474	0.000
ITIN -> OC	0.690	0.692	0.069	9.943	0.000
ITIN -> RLC	0.910	0.911	0.017	53.998	0.000
ITIN -> SCOP	0.724	0.724	0.062	11.749	0.000
OC -> SCOP	0.795	0.786	0.056	14.095	0.000
RLC -> SCOP	0.096	0.100	0.090	1.067	0.143

Indirect effect of the independent variable on the dependent has been evaluated by mediation analysis by the use of an intervening variable.



**Table 5.** Mediation

	(O)	(M)	(STDE V)	( O/STDE V )	P Value s
ITIN -> ITC -> SCO P	0.28 8	0.29 3	0.074	4.195	<b>0.000</b>
ITIN -> OC - -> SCO P	0.54 9	0.54 1	0.040	13.570	<b>0.000</b>
ITIN -> RLC -> SCO P	0.08 8	0.09 1	0.082	1.069	<b>0.143</b>

The coefficient of determination (R<sup>2</sup>) is the widely used method for determining the conceptual model. It explains the predictive power of the explanatory variables [25]. The value of R<sup>2</sup> is considered weak, moderate, and good when it is 0.20, 0.35, and 0.55. When the value of R<sup>2</sup> is 0.55, it means 55% variations in the dependent variable are explained by the exogenous variable in the model.

**Table 6.** R-square

	R Square
ITC	0.796
OC	0.476
RLC	0.829
SCOP	0.876

## 5. Conclusion

Increased global SC complexity requires manufacturers to particularly emphasize on SC performance. Researchers have identified SC capabilities as one of the key performance improvement factors. Although, a few firms could not learn and understand the significance of SCC and failed to fully utilize and focus on those capabilities which they already had. Therefore, subject to the findings obtained from the literature review, IT capability, organizational culture capability and relational capability are the major SC capabilities (SCC) components for improving SC performance. IT significantly influences BPR (such as, SC management, and product development) which thus influence operational performance. In an attempt to study the role of BPR as a mediator on IT and firm performance relationship. Evidently, the difference in

organizational structures, cultures and economic development stages in developing and developed economies may influence business value of IT. Practitioners and academics have also been emphasizing upon issues concerning operational performance and IT investment. The significance of IT and SCM are the widely studied areas, and we also found some studies that investigated SC capability as a mediator in context to IT influencing SC performance (SCP). Present research used the process-view literature and tries to analyze the distinct impact of internal BPR as a mediator to that of SC management

This research presents avenues for the future studies about firm performance and IT relationship. Firstly, from the process-based view, the role of intermediate BPR needs to be examined as a direct role on the IT investment's impact on firm performance. Thus, a new approach has been adopted in present research by proclaiming the need to consider process management capabilities. Two process management capabilities that are discussed in this study include: external SC management capability and internal BPR management capability. Other potential management capabilities must also be considered in future researches, for instance, customer relationship management capability.

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